Megadroughts in Northeastern US History – Implications for our Future?

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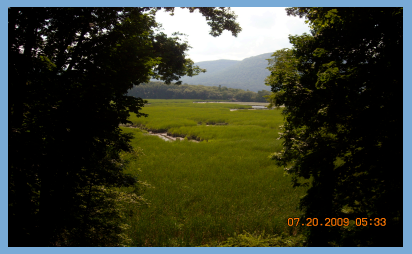


Key Findings

Photo by S.Vincent

*Droughts are rare in the NE US recent history, but sediment cores from New York marshes confirm major droughts major can occur.

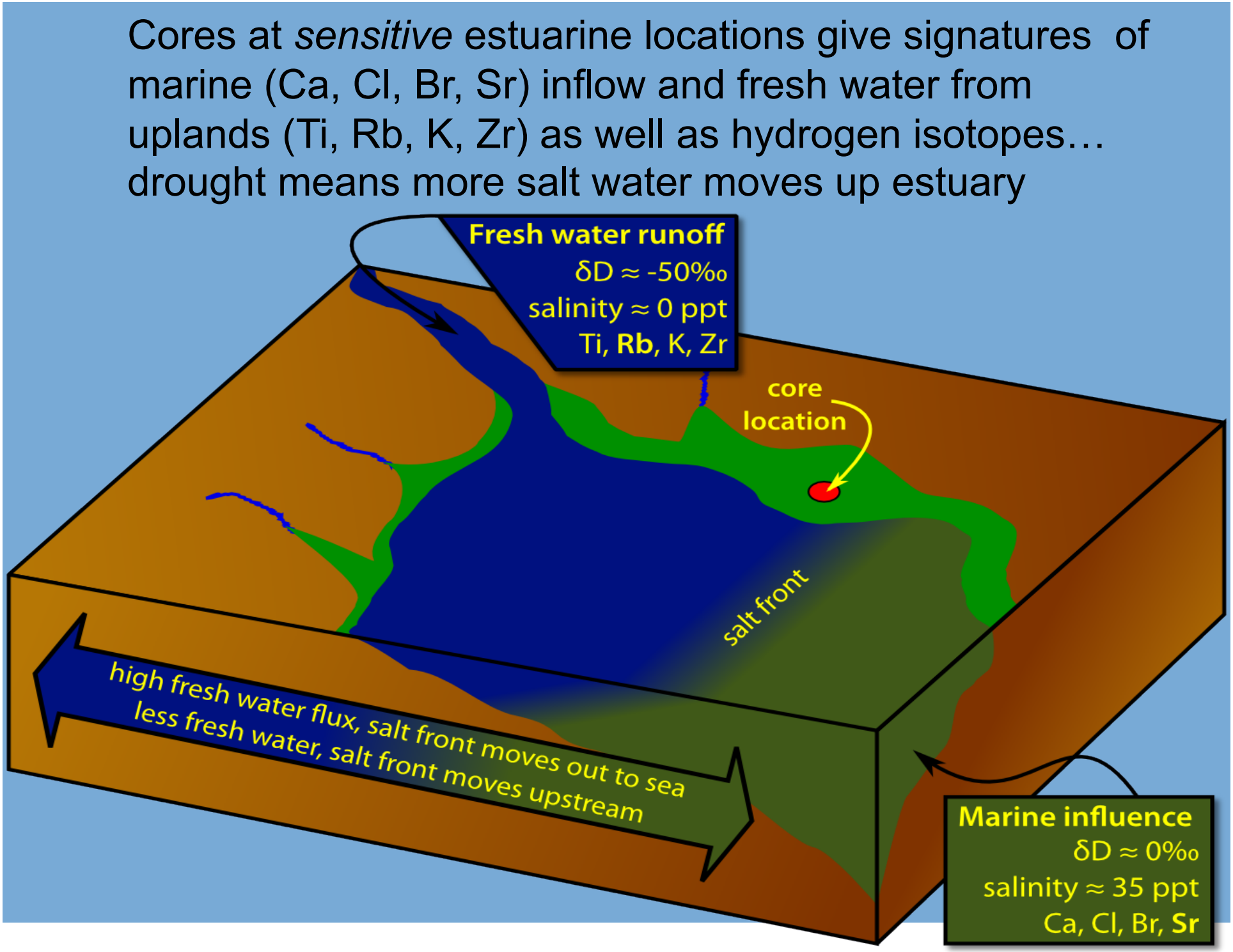
*Cores indicate at least three "megadroughts" have occurred in the last 6,000 years.

*The longest – detectable in cores as a thick charcoal layer, changes in pollen, foraminifera, and seed assemblages, and evidence of salt water moving up the Hudson – began around 850 C.E. and lasted about 500 years until 1350 C.E. (Medieval Warm Period, MWP).

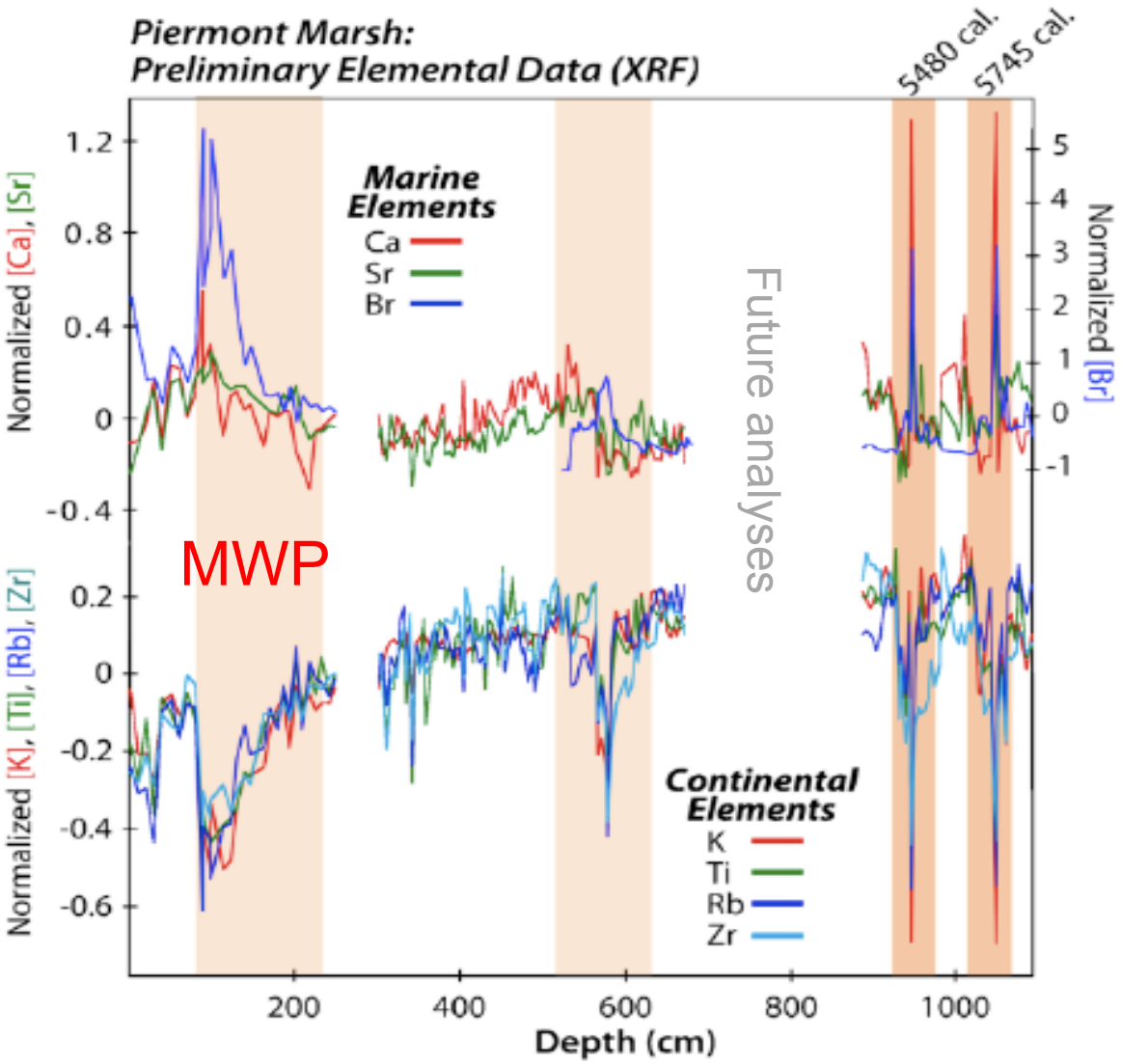
*Shorter but possibly more intense droughts occurred 5,480 and 5,745 years ago as seen by new XRF data.

*More research needed to confirm how widespread the droughts were and why they occurred.

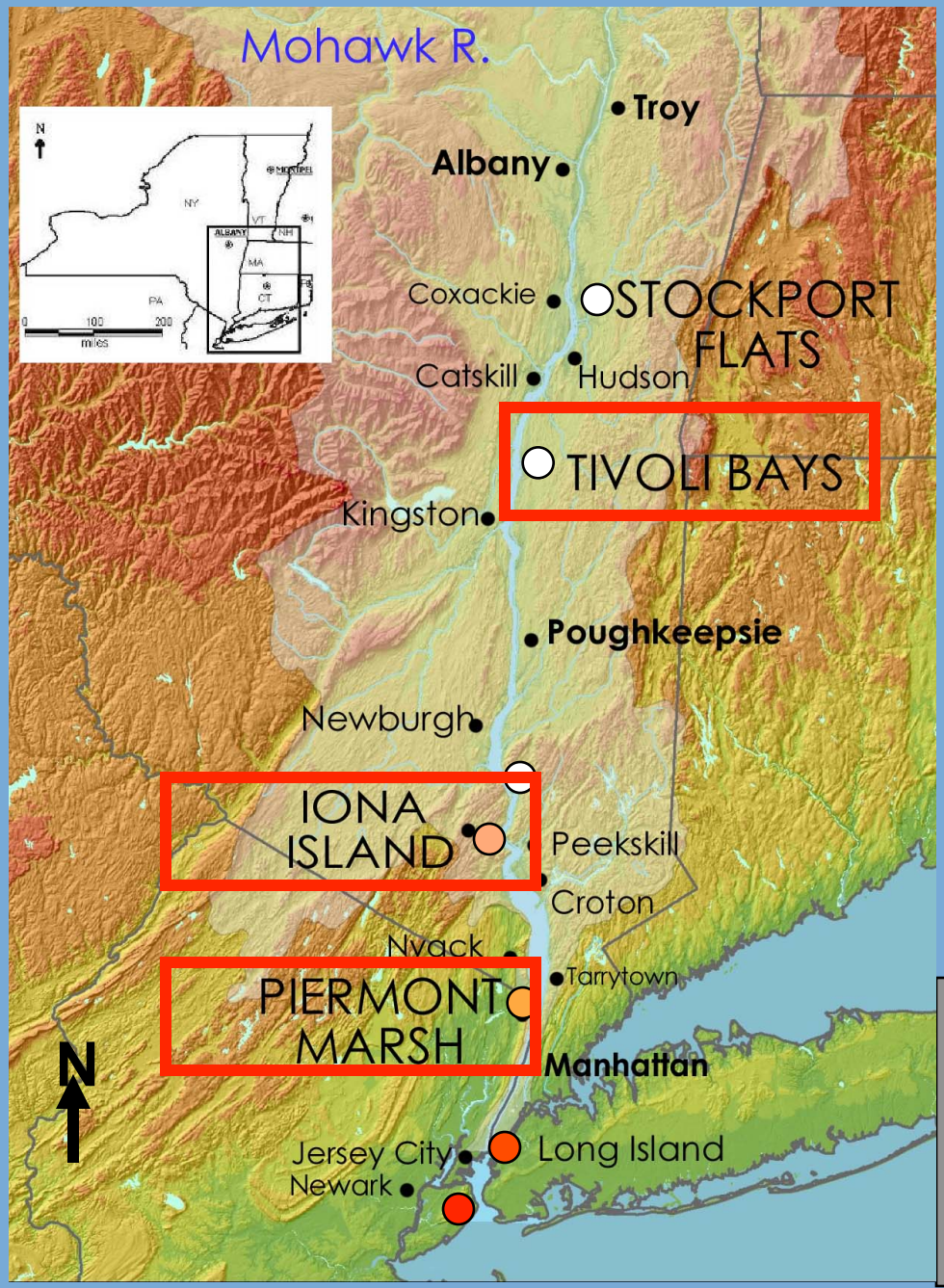
Cores at *sensitive* estuarine locations give signatures of marine (Ca, Cl, Br, Sr) inflow and fresh water from uplands (Ti, Rb, K, Zr) as well as hydrogen isotopes… drought means more salt water moves up estuary

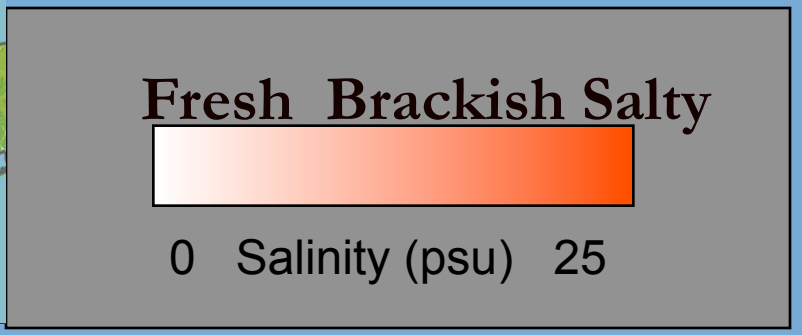


Droughts are visible by *increases* in *marine* elements, declines in continental elements; droughts 5-6000 years ago also evident



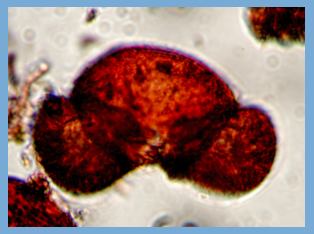
Coring: Iona Marsh



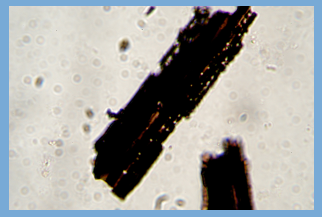


Pollen ⇨ Vegetation ⇨ Climate

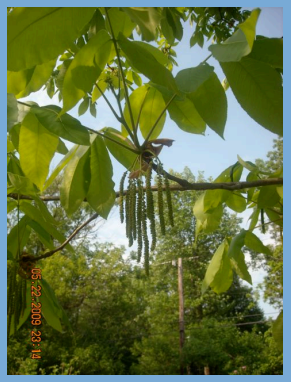
Dry, warm climate



pine

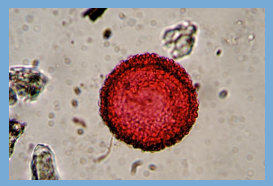


charcoal



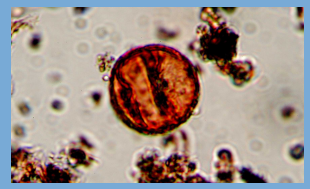
hickory

Cool, wetter climate



hemlock

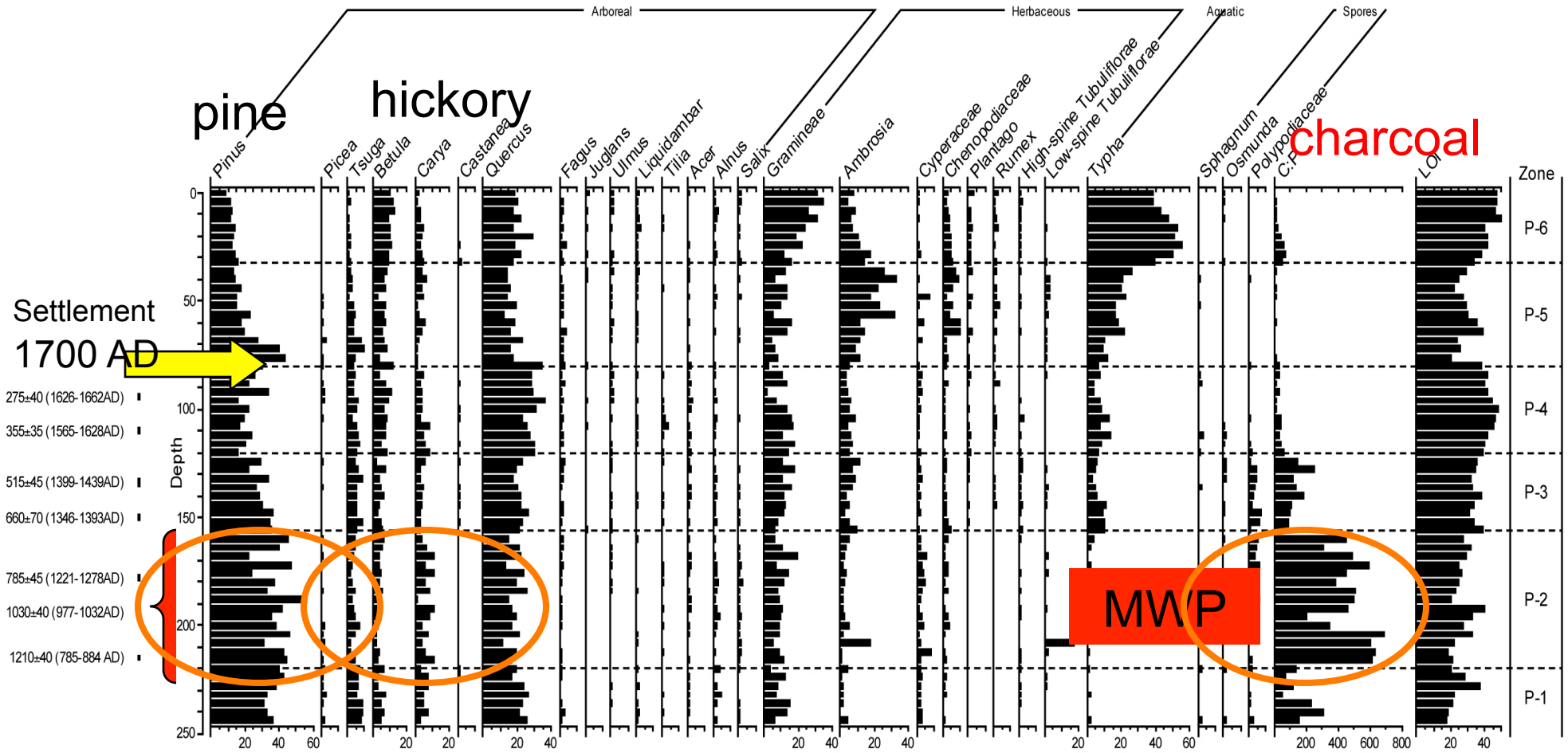
oak



beech

Piermont North Pollen Percentage Data

Increase of pine, hickory, charcoal



Pederson et al., 2005

Tivoli North Bay, New York

Pinus
Picea
Tsuga
Betula
Carya
Quercus
Liquidambar
Alnus
Gramineae-Large
Ambrosia
Chenopodiaceae
Nymphae
Osmunda
Polypodiaceae

Depth (cm)

0-
10-
20-
30-
40-
50-
60-
70-
80-
90-
100-

Little Ice Age
1400-1800
A.D.

MWP

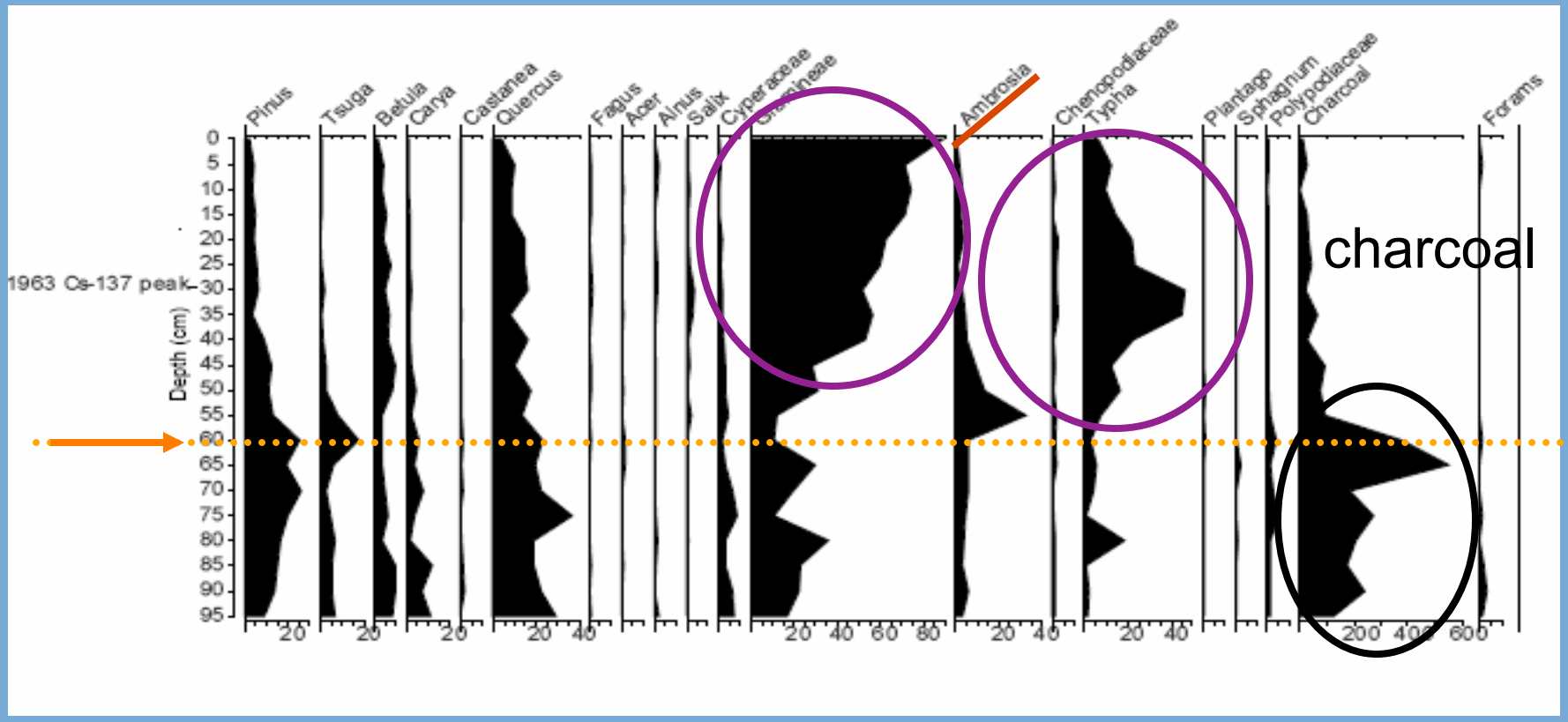
1000 AD

Charcoal

20 20 20 40 20 40 60 80 20 20 20 20 40 100 200 300

Pollen and spore percentage

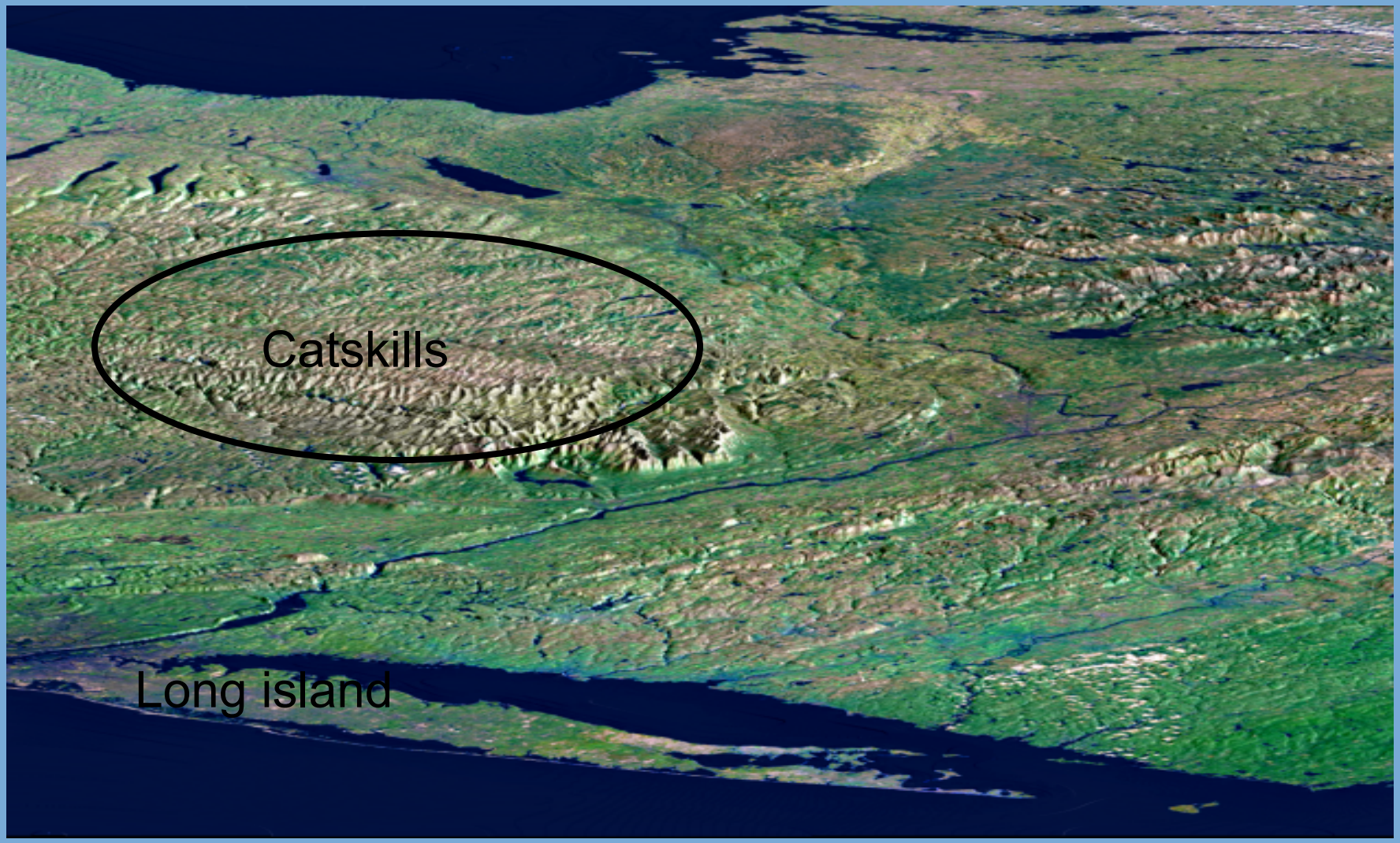
Iona Marsh - grass, cattails (human impact increases), and charcoal in the top meter of 9-meter core



90% of NYC water supply

NYC Water supply sensitivity-
Catskills 90% water supply

10 million people
Storage capacity 1 year
1961: 100% capacity
1963: only 26% capacity



Conclusions and Future Research

* Hudson marshes reveal at least 3 significant droughts in past 6000 years

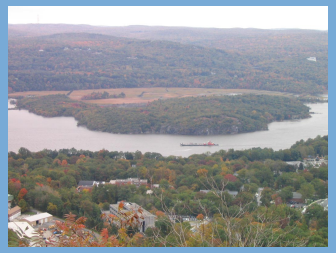
*Establish drought frequency & duration over past 15,000 years in Hudson Valley & Northeastern US

-Use XRF to fill in gaps in Piermont, Iona cores - watershed

-Use hydrogen & oxygen isotopes to further identify droughts

-Expand to other marshes, estuaries in northeastern US

-Link droughts to upland sediment cores from lakes



*Using climate models (statistical & GCM's), determine drought mechanisms

*Improve drought prediction –severity, timing, extent

Past evidence of Megadroughts longer than the 1960's drought indicates NY region needs preparation: water supplies, agriculture, erosion, social order

Sanford Gifford, Hudson River School Of Painters

Cat. 43